406 MHz EMERGENCY BEACON WITH IN-BAND HOMING TRANSMITTER

Cross Reference to Related Application

This application claims priority from United States Provisional Patent Application No. 60/422,894 filed November 1, 2002 entitled 406 MHz Emergency Beacon with In-Band Homing Transmitter.

Field of the Invention

An emergency beacon is provided that incorporates an auxiliary transmitter, which is very close in frequency to 406 MHz, for use as a homing signal.

Background of the Invention

Emergency beacons operating at 406 MHz have seen worldwide acceptance over the past decade or so. The 406 MHz beacon population is over 250,000, and the Cospas-Sarsat (C-S) satellites and system infrastructure have seen significant improvements over the years. The C-S system is likely to be around for a long time. However, reference to C-S herein is intended to encompass any similar system which may replace the present C-S system within the term of this patent.

Although C-S requirements only addresses the 406 MHz portion of the beacons, most national authorities require the use of an auxiliary 121.5 MHz, low power, homing transmitter in all beacons. Prior to 406 MHz technology becoming widely available, 121.5 MHz-only beacons were used. The 121.5 MHz-only beacons are being phased out. Recently C-S decided to terminate the satellite processing of 121/243 MHz signals based on recommendations from the International Maritime Organization (IMO) and the International

Civil Aviation Organization (ICAO). This means that existing 121.5 MHz-only beacon users have to switch to a 406 MHz beacon.

Currently, to the best of applicant's knowledge all 406 MHz beacons have a 121.5 MHz transmitter that is used as a homing signal for aiding search and rescue (SAR) aircraft for homing the last few kilometres into the beacon. Technical problems, such as set out below, experienced during development of these beacons have mostly been overcome, but the developments have added cost and complexity to the beacon. Operational problems, such as when a user decides to hold his emergency position indicating radio beacon (EPIRB) instead of allowing it to float, still cause problems.

When an activated EPIRB is held by a survivor in a life raft, the transmitted signal may be attenuated significantly enough to preclude reception by the SAR airplane or helicopter. This defeats the purpose of having a homing signal in the beacon. The problem arises from the fact that most EPIRBs have an antenna that is optimized for 406 MHz operation, thus resulting in an electrically short antenna at 121.5 MHz which is very narrowband and very dependent on the water, which is acting as the antenna's ground plane, for proper radiation characteristics. When it is operated out of the water, the antenna is detuned (presenting a severe mismatch to the output power amplifier) and the ground plane effect is removed resulting in a reduction in the radiated signal. As beacons have become physically smaller over the years, this problem has been made worse. The 121.5 MHz homing transmitter in 406 beacons has been the cause of many problems. Such problems range from designing to meet the multitude of stringent signal parameters to the generation of harmonics causing interference problems in location protocol beacons. In the case of emergency locator transmitters (ELTs), energy from the aircraft VHF radio would be rectified in the unpowered ELT's 121.5 MHz output stage and produce an interfering signal for the aircraft's global positioning system (GPS) receiver. Overcoming these problems has added cost and complexity to 406 beacons. Problems have plagued 121.5 MHz beacons even long before the introduction of the superior 406 MHz technology.

Summary of the Invention

This invention provides a SAR beacon with a homing transmitter transmitting at a frequency close to the frequency of the main C-S signal. Both signals are generated by a single synthesizer switching between the main C-S burst transmission and the continuous homing frequency transmission close in frequency. This will alleviate many of the technical issues and operation issues that the 121.5 MHz transmitters have caused.

Homing equipment operating at 406 MHz is not new; however, it is not practical because of the burst mode transmission characteristic of the C-S signal in all 406 beacons.

Replacing the 121.5 MHz homing transmitter with a homing signal close to the main frequency, for example 406 MHz, would result in:

1. reducing the cost of 406 MHz beacons;
2. eliminating the need for a second transmitter;
3. eliminating the need for a dual frequency diplexer;
4. eliminating the need to match to an electrically short antenna;
5. reducing the problems currently experienced when users hold their EPIRBs;
6. reducing RF interference problems in location protocol beacons; and,
7. reducing L band interference generated when using aviation radios.

In summary, the search and rescue beacon according to the present invention includes a main transmitter transmitting a Cospas-Sarsat signal at a main frequency and an auxiliary homing transmitter transmitting a homing signal at a homing frequency close to the main frequency. Advantageously both the Cospas-Sarsat signal and the homing signal are generated by a single synthesizer switching between a main Cospas-Sarsat burst transmission

and a continuous homing frequency transmission of the homing signal. The homing signal is advantageously transmitted at a lower power than the COSPAS-SARSAT signal. The single synthesizer may use a single amplifier chain. The single synthesizer and amplifier chain may use a single antenna.

In one embodiment, the main frequency is 406.028 MHz and the homing frequency is dedicated in a lower part or in an upper part of a 406 - 406.1 MHz frequency band.

Brief Description of the Drawings

Figure 1 is a schematic illustration of the present invention.

Detailed Description of Embodiments of the Invention

The present invention is an emergency beacon that uses a homing transmitter that is close in frequency to the 406 MHz used by the international COSPAS-SARSAT (C-S) satellite system for search and rescue. The emergency beacon may be an Emergency Position Indicating Radio Beacon (EPIRB), an Emergency Locator Transmitter (ELT), or a Personal Locator Beacon (PLB) or any combination of these, or any other beacon that utilizes the C-S satellite system.

Conventionally the main 406 MHz C-S signal is a medium power burst transmission. Each transmission has a duration of approximately half a second and occurs approximately every 50 seconds. The homing signal is transmitted continuously except during the C-S signal transmission. In the present invention the homing signal is a low power signal that is close to 406 MHz, for example using the lower or upper part of the 406-406.1 MHz band for a dedicated homing frequency. The C-S signal and the homing signal efficiently use the same synthesizer, antenna, and amplifier chain with slightly different biasing. Using *a* low

cost synthesizer, the transmitter frequency can be shifted between the C-S main signal and the homing signal very easily and with great accuracy. It is intended to be within the scope of this invention that the SAR C-S frequency may be other than 406.028 MHz and that the homing signal frequency may be other than in the 406-406.1 range so long as within the available bandwidth for a particular SAR C-S frequency.

As seen in Figure 1, which is intended to illustrate merely one embodiment according to the present invention and not intending to be limiting, master oscillator 10 provides an oscillating signal to a single synthesizer 12. The single synthesizer 12 outputs a burst signal at the SAR C-S transmitter frequency (now-conventionally at 406.028 MHz), and, alternatingly, a continuous homing beacon signal, for example at 406.075 MHz, illustrated in Figure 1 as C-S/homing signal 14. A controller 16 provides the necessary control signals 18 to synthesizer 12 to select between the C-S frequency or the homing frequency. In the embodiment illustrated, the signal 20 from the synthesizer is modulated by a modulator 22 to insert information generated by the modulation generator 24 as required. The C-S signal is modulated by modulator 22 so as to include the signal information allowing each beacon to be uniquely identified. The homing signal is modulated as necessary such as digitally to include any information deemed valuable, swept tone audio, steady tone audio, or any combination of these, or no modulation at all to facilitate homing by a suitable receiver.

The modulated C-S signal or homing signal is amplified by amplifier stages 26. The controller 16 provides a control signal 28 to the amplifier chain to select medium power (for example 5W) for use when the C-S signal is transmitted or low power (for example 50mW) for use when the homing signal is transmitted. The C-S signal or homing signal is then transmitted by the antenna, illustrated by way of a monopole antenna 30, it being understood that the desired form of antenna may take a different form as would be known to one skilled in the art.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.